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TITLE: Plasma etching with less etching rate fluctuation - includes cleaning process using gas containing fluorine@, conditioning and etching using gas containing chlorine@

PRIORITY-DATA:
1995JP-0241267

September 20, 1995

Nawata et al.
Makoto

PATENT-FAMILY:

PUB-NO	PUB-DATE	LANGUAGE	PAGES	MAIN-IPC
JP 09082690 A	March 28, 1997	N/A	005	H01L021/3065

INT-CL (IPC): C23F 4/00; H01L 21/304; H01L 21/3065; H05H 1/46

ABSTRACTED-PUB-NO: JP09082690A
BASIC-ABSTRACT:

Plasma etching is achieved by: (1) cleaning using gas containing F; (2) conditioning using plasma of etching gas using Si substrate; and (3) etching using Cl2 or mixed gas of Cl2 or mixed gas of Cl2 and O2.

ADVANTAGE - The plasma etching can suppress the fluctuation of etching rate to improve uniformity between wafers.

L9 ANSWER 2 OF 5 JAPIO COPYRIGHT 2000 JPO
AN 1997-082690 JAPIO
TI PLASMA ETCHING METHOD
IN NAWATA MAKOTO; YAKUSHIJI MAMORU; TSUKUNI KAZUYUKI; YAMAZAKI KAZUO
PA HITACHI LTD, JP (CO 000510)
PI JP 09082690 A 19970328 Heisei
AI JP1995-241267 (JP07241267 Heisei) 19950920
SO PATENT ABSTRACTS OF JAPAN (CD-ROM), Unexamined Applications, Vol. 97, No. 3
IC ICM (6) H01L021-3065
ICS (6) C23F004-00; (6) H01L021-304; (6) H05H001-46
AB PURPOSE: TO BE SOLVED: To restrain **cleaned silicon** and an **oxide film (SiO2)** as a ground film from varying in **etching rate** so as to improve **wafers** in uniformity.
CONSTITUTION: oning is carried out with plasma of **Cl2** gas by the use of a **silicon** substrate after **cleaning** to reduce the influence of **residues** left inside a **cleaned** processing chamber after **cleaning**, and furthermore processing (**Cl2** gas discharge) is carried out with **Cl2** plasma by the use of a substrate which comprises an **Si** substrate and an **oxide film** formed on it to reduce the influence of **residues** left inside the processing chamber after **seasoning**.

TI Plasma etching of silicon semiconductor wafer including seasoning
 IN Nawata, Makoto; Yakushiji, Mamoru; Tsukuni, Kazuyuki; Yamazaki, Kazuo
 PA Hitachi, Ltd., Japan
 SO Jpn. Kokai Tokkyo Koho, 5 pp.
 CODEN: JKXXAF
 DT Patent
 LA Japanese
 IC ICM H01L021-3065
 ICS C23F004-00; H01L021-304; H05H001-46
 CC 76-3 (Electric Phenomena)
 FAN.CNT 1

(Si-Cl or Si-Cl-O)
 seasoning film
 inherently
 forms

	PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI	JP 09082690	A2	19970328	JP 1995-241267	19950920
AB	The method involves the following steps; (1) cleaning the etching app. with a F-contg. gas plasma, (2) seasoning by supplying Cl ₂ (and optionally O ₂) to etch a (polycryst.) Si or a silicide at .ltoreq.20 mTorr, (3) seasoning by supplying a etching gas plasma to etch a Si substrate, (4) treatment of a Si substrate having a SiO ₂ film coating with a Cl ₂ plasma, and (5) etching of a Si semiconductor wafer. The pre- and post cleaning of the app. inhibits dropping of the etching rate in etching of Si - and Si oxide films.				
ST	plasma etching app cleaning; silicon semiconductor wafer plasma etching app; seasoning plasma etching app cleaning				
IT	Plasma etching Semiconductor materials (plasma etching of silicon semiconductor wafer including cleaning and seasoning)				
IT	2551-62-4, Sulfur hexafluoride 7782-41-4, Fluorine, uses 7782-44-7, Oxygen, uses 7782-50-5, Chlorine, uses 7783-54-2, Nitrogen trifluoride 7790-91-2, Chlorine fluoride (ClF ₃) 13709-36-9, Xenon difluoride				
	RL: NUU (Nonbiological use, unclassified); USES (Uses) (etchant; in plasma etching of silicon semiconductor wafer including cleaning and seasoning)				
IT	7440-21-3, Silicon, processes RL: DEV (Device component use); PEP (Physical, engineering or chemical process); PROC (Process); USES (Uses) (plasma etching of silicon semiconductor wafer including cleaning and seasoning)				
IT	7631-86-9, Silicon dioxide, processes RL: DEV (Device component use); PEP (Physical, engineering or chemical process); PROC (Process); USES (Uses) (primer coatings; plasma etching of silicon semiconductor wafer including cleaning and seasoning)				

(19) 日本国特許庁 (J P)

(12) 公開特許公報 (A)

(11) 特許出願公開番号

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C 2 3 F 4/00			C 2 3 F 4/00	E
H 0 1 L 21/304	3 4 1		H 0 1 L 21/304	3 4 1 D
H 0 5 H 1/46			H 0 5 H 1/46	B
			H 0 1 L 21/302	F
審査請求 未請求 請求項の数9 O L (全 5 頁)				

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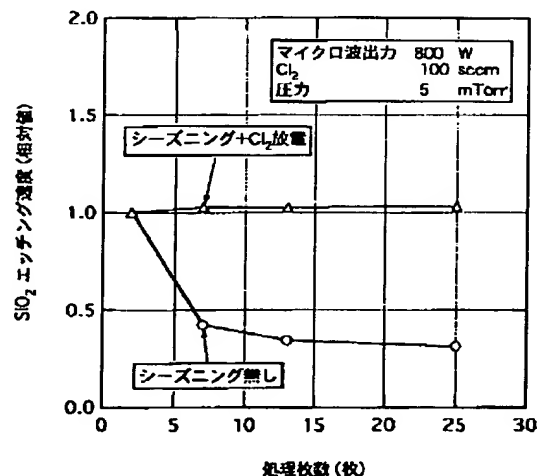
(54) 【発明の名称】 プラズマエッチング方法

(57) 【要約】

【目的】クリーニング後のシリコン及び下地膜である酸化膜 (SiO_2) のエッチング速度の変化を抑制しウエハ間の均一性を向上させる。

【構成】クリーニング後にシリコン基板を用いて Cl_2 ガスプラズマでシーズニングを行い、クリーニング後の処理室内の残留物の影響を減少させ、さらに Si 基板上に酸化膜 (SiO_2) を形成した基板を用いて Cl_2 プラズマによる処理 (Cl_2 放電) を行い、シーズニング後の処理室内の残留物の影響を減少させる。

図 1



【特許請求の範囲】

【請求項1】フッ素を含むガスプラズマによりクリーニングを行い、クリーニング後、塩素ガス (Cl_2) の単独ガスあるいは塩素ガス (Cl_2) と酸素ガス (O_2) の混合ガスをエッチングガスとして用い、ガス圧力20m Torr以下でシリコン、多結晶シリコンまたはシリサイドのエッチングを行うエッチング装置において、クリーニング後にシリコン (Si) 基板を用いてエッチングガスのプラズマで馴染し放電を行い、さらに Si 基板上に酸化膜 (SiO_2) を形成した基板を用いて Cl_2 プラズマによる処理を行った後エッチングを開始することを特徴とするプラズマエッチング方法。

【請求項2】請求項1記載のプラズマエッチング方法において、前記フッ素を含むガスプラズマによるクリーニング、馴染し放電および Cl_2 プラズマ処理を行った後エッチングを開始する前に前記被処理基板と同一のパターンを形成したシリコン基板および酸化膜基板を1枚ずつダミーエッチングするプラズマエッチング方法。

【請求項3】請求項2記載のダミーエッチングにおいて、前記シリコン基板の処理時間をエッチング処理を行う前記被処理基板のジャストエッチング時間とし、酸化膜基板の処理時間をエッチング処理を行う前記被処理基板のオーバーエッチング時間とするプラズマエッチング方法。

【請求項4】請求項1記載の前記フッ素を含むガスが六フッ化硫黄 (SF_6)、三フッ化窒素 (NF_3)、二フッ化キセノン (XeF_2)、フッ素 (F_2)、三フッ化塩素 (ClF_3) の単独ガスあるいは混合ガスであるプラズマエッチング方法。

【請求項5】請求項1記載の前記馴染し放電において、 SiF の発光スペクトルをモニターし、該発光スペクトルの強度の時間変化が一定値以下になった時点で、馴染し放電を終了しエッチングを開始するプラズマエッチング方法。

【請求項6】請求項1記載の前記馴染し放電において、 Si 表面に酸化膜 (SiO_2) を形成した基板或いは石英基板を用い、プロセスガスとして Cl_2 と SiCl_4 の混合ガスを使用するプラズマエッチング方法。

【請求項7】請求項1記載の前記 Cl_2 プラズマ処理において、 Si の発光スペクトルをモニターし、該発光スペクトルの強度の時間変化が一定値以下になった時点で、 Cl_2 プラズマ処理を終了しエッチングを開始するプラズマエッチング方法。

【請求項8】請求項1記載の前記 Cl_2 プラズマ処理において、石英基板を用いるプラズマエッチング方法。

【請求項9】請求項1記載のプラズマエッチング方法において、エッチング開始時の放電管の温度あるいは処理室の温度を100℃以上とするプラズマエッチング方法。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明はプラズマエッチング方法に係り、特に、シリコン、多結晶シリコンまたはシリサイドのエッチングに好適なプラズマエッチング方法に関するものである。

【0002】

【従来の技術】従来、平塚豊著、「ドライプロセス装置のチャンバクリーニング」、洗浄設計1992、Summer, P41-53に記載のように、エッチング等のプラズマプロセスでは、ウエハの粒子汚染を防止するためにクリーニングを行い、クリーニング後の処理室内の残留物をなくすためにポストクリーニングを行っている。 SF_6 、 NF_3 ガスをクリーニングに用いた場合には N_2 、 Ar 、 H_2 、 O_2 ガスプラズマがポストクリーニングに用いられている。

【0003】

【発明が解決しようとする課題】従来のエッチング方法では、クリーニング後の処理室内の残留物のエッチング特性に及ぼす影響について考慮されておらず、クリーニング後処理枚数とともにシリコン及び下地膜の酸化膜のエッチング速度が減少し、下地酸化膜の残膜が変動するという問題点があった。

【0004】本発明の目的は、クリーニング後のシリコン及び酸化膜のエッチング速度の減少を抑制し下地酸化膜の残膜の変動を防止し良好なウエハ間の均一性が得られるエッチング方法を提供することにある。

【0005】

【課題を解決するための手段】上記目的は、クリーニング後にエッチングガスである Cl_2 あるいは Cl_2 と O_2 の混合ガスプラズマによりダミーのシリコン基板を用いて馴染し放電 (シーズニング) を行い、次に、馴染し放電後にシリコン表面に酸化膜を形成したダミーのシリコン基板或いは石英基板を用いて Cl_2 ガスプラズマ処理 (Cl_2 放電) を行ない、その後所定のエッチング処理を行なうようにすることにより、達成される。

【0006】

【作用】まず、クリーニング後にエッチングガスである Cl_2 あるいは Cl_2 と O_2 の混合ガスプラズマによって馴染し放電 (シーズニング) を行なうことにより、クリーニング後の処理室内の残留フッ素の影響を減少させることができ、次に馴染し放電後に Cl_2 ガスプラズマによって Cl_2 プラズマ処理を行なうことによって、馴染し放電後の処理室内のシリコンの反応生成物の影響を減少させることができ、クリーニング後のシリコン及び酸化膜のエッチング速度の減少を抑制し下地酸化膜の残膜の変動を防止して良好なウエハ間の均一性を得られる。

【0007】

【実施例】まず、図4に、 SF_6 ガスプラズマでクリーニングを行った後、 Cl_2 ガスプラズマでシリコンをエッチングした場合における SiF (波長441nm) の

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発光スペクトルの処理枚数による変化を示す。シリコンとフッ素の反応によって生成するSiFの発光スペクトルの強度は処理枚数とともに減少しほぼ一定となる。このことからフッ素を含むガスによるクリーニング後、処理室内にはフッ素が残留していることが分かった。図5、図6に、Cl₂ガスにSF₆ガスを添加した場合のSiFの発光スペクトルとシリコン及び酸化膜のエッチング速度の変化を示す。図5、図6に示すようにSF₆の添加量の増加とともにSiF（波長441nm）の発光スペクトルの強度は増加する。SF₆の添加量の増加とともにシリコン及び酸化膜のエッチング速度は増加する。このことから残留フッ素によりシリコン及び酸化膜のエッチング速度は変動し、残留フッ素の減少とともにシリコン及び酸化膜のエッチング速度が低下することを見出した。

【0008】前述のCl₂ガスプラズマによるシリコンのエッチングは、クリーニング後の馴染み放電、すなわち、シーズニングに相当する。シーズニング後の処理室内にはシリコン系の反応生成物（SiあるいはSiCl_x）が残留していることがSiの発光スペクトルからわかった。図7に、Cl₂ガスにSiCl₄ガスを添加した場合の酸化膜のエッチング速度の変化を示す。酸化膜のエッチング速度はSiCl₄の添加量の増加とともに減少する。このシリコン系の反応生成物のためにシーズニング直後のシリコン酸化膜のエッチング速度が減少していることを見出した。

【0009】上述のこれらにより、フッ素を含むプラズマによるクリーニング後にシーズニングを行い、クリーニング後の処理室内に残留するフッ素の除去を行うことにより、シリコン及び酸化膜のエッチング速度の変動を抑制でき、さらにシーズニング後にCl₂ガスを用いたプラズマ処理、すなわち、Cl₂放電を行い、シーズニング後の処理室内に残留するシリコンの反応生成物の除去を行うことにより、酸化膜のエッチング速度の変動を抑制できることを見出した。

【0010】以下、本発明の一実施例を図1ないし図3により説明する。図3は、本発明の方法を実施するためのプラズマ処理装置の一例であるマイクロ波プラズマエッチング装置の概略を示した図である。マグネトロン1から発振したマイクロ波は導波管2を伝播し石英製放電管3を介して処理室4に導かれる。磁界発生用直流電源5からソレノイドコイル6、7に供給される直流電流によって形成される磁界とマイクロ波電界によってエッチングガス供給装置8から供給されるクリーニングガス（SF₆）、シーズニングガス（Cl₂ガス）、Cl₂放電ガス（Cl₂）及びエッチングガス（Cl₂ガス）は、それぞれのステップでプラズマ化される。

【0011】まず、SF₆ガスプラズマにより処理室4のクリーニングが行われる。その後、シリコン基板を用いてCl₂ガスプラズマにより処理室4のシーズニング

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が行われる。さらにシリコン表面に酸化膜を形成したシリコン基板或いは石英基板を用いてCl₂放電が行われる。クリーニング、シーズニング、Cl₂放電の後、Cl₂ガスにより載置電極9に載置されているウエハ10のエッチングが行われる。クリーニング、シーズニング、Cl₂放電及びエッチング時の圧力は真空排気装置11によって制御される。また、ウエハに入射するイオンのエネルギーは載置電極9に高周波電源12から供給される高周波電力によって制御される。

【0012】図1、図2にシーズニングの無い場合とシーズニングとCl₂放電を行った場合のシリコン及び酸化膜のエッチング速度の変化の違いを示す。シーズニングはCl₂ガスプラズマにより行い、SiFの発光スペクトルを10秒毎にモニタし時間t(n)と時間t(n-1)に測定したスペクトルの発光強度比が1±0.002になった時点でシーズニングを停止した。クリーニング後にシーズニングを行うことによりクリーニング時に生成されるフッ素の残留の影響を抑制しエッチング速度の変動を防止できる。Cl₂放電は高周波電力を印加せずCl₂ガスプラズマによりシリコンの反応生成物の除去を行う。Siの発光スペクトルを10秒毎にモニタし時間t(n)と時間t(n-1)に測定したスペクトルの発光強度比が1±0.002になった時点でCl₂放電を停止した。シーズニング後にCl₂放電を行うことによりシーズニング時に生成されるシリコンの反応生成物の残留の影響を抑制し下地酸化膜のエッチング速度の変動を防止できる。

【0013】本実施例によれば、クリーニング後の残留フッ素の影響を抑制しシリコン及び酸化膜のエッチング速度の変動を防止することができる。また、シーズニング後のシリコンの反応生成物の影響を抑制し下地酸化膜のエッチング速度の変動を防止することができる。

【0014】本実施例ではマイクロ波プラズマエッチング装置についてその効果を説明したが、他の放電方式例えばプラズマエッチング（PE）、ヘリコン、TCP（Transformer Coupled Plasma）においても同様な効果が得られる。

【0015】

【発明の効果】本発明によれば、クリーニング後の残留フッ素及びシーズニング後のシリコンの反応生成物の影響を抑制しシリコン及び酸化膜のエッチング速度の変動を防止することができるという効果がある。

【図面の簡単な説明】

【図1】本発明の一実施例におけるSiO₂エッチング速度の処理枚数依存性を示す図である。

【図2】本発明の一実施例におけるSiエッチング速度の処理枚数依存性を示す図である。

【図3】本発明の方法を実施するための装置の一例を示すマイクロ波プラズマエッチング装置の構成を示す図である。

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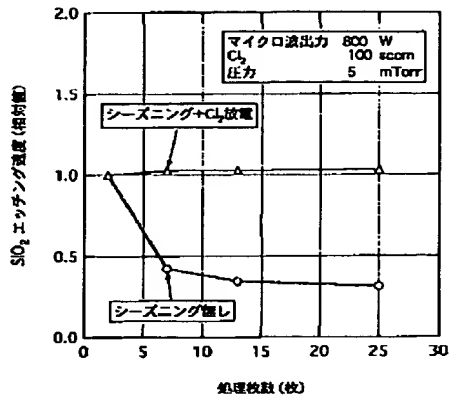
【図4】SiF発光強度の処理枚数依存性示す図である。

【図5】SiF発光強度のSF₆添加量依存性を示す図である。

【図6】Si及びSiO₂エッチング速度のSF₆添加量依存性を示す図である。

【図1】

図 1



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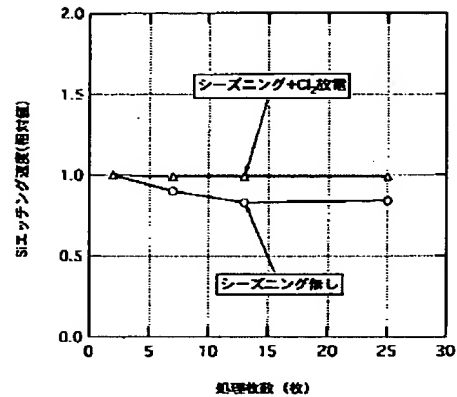
【図7】SiO₂エッチング速度のSiCl₄添加量依存性を示す図である。

【符号の説明】

3…石英製放電管、6、7…ソレノイドコイル、8…エッチングガス供給装置、10…ウエハ。

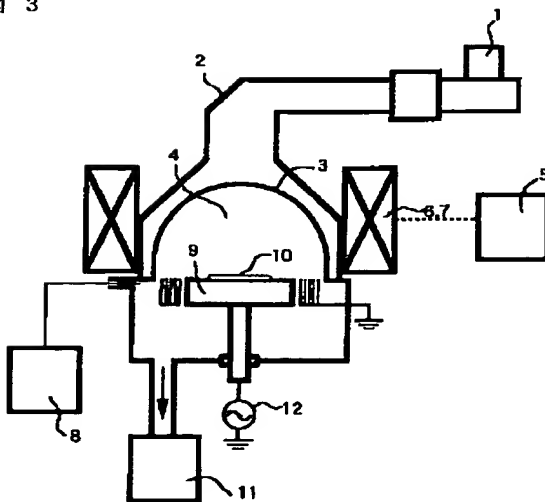
【図2】

図 2



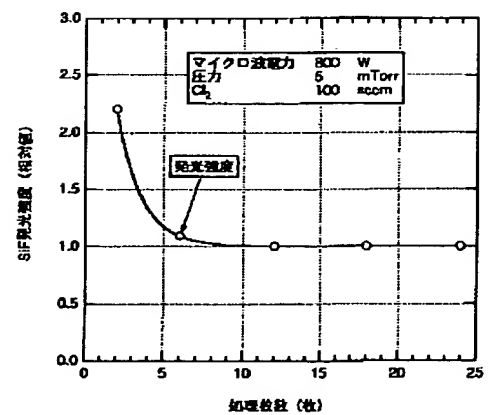
【図3】

図 3



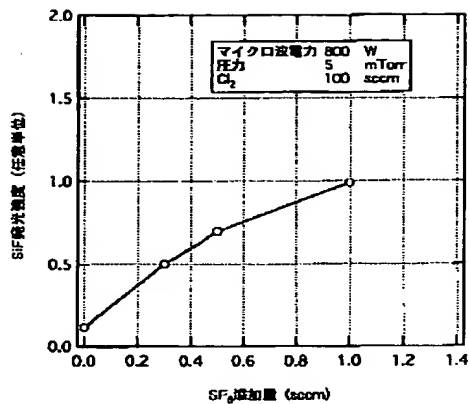
【図4】

図 4



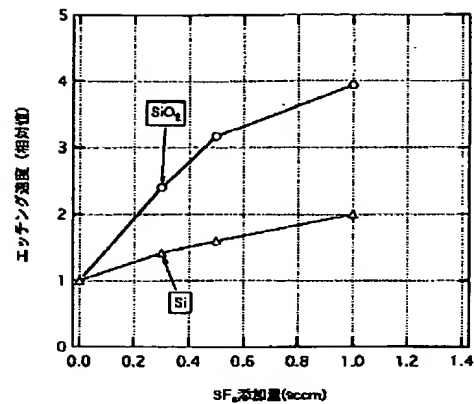
【図5】

図 5



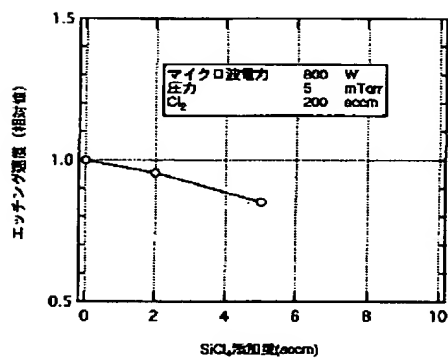
【図6】

図 6



【図7】

図 7



フロントページの続き

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09-082,690

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CLAIMS

[Claim(s)]

[Claim 1] It cleans by the gas plasma containing a fluorine. After cleaning, The mixed gas of the independent gas of chlorine gas (Cl₂) or chlorine gas (Cl₂), and oxygen gas (O₂) is used as etching gas. In the etching system which performs etching of silicon, polycrystal silicon, or a silicide with 20 or less mTorr of gas pressure The plasma-etching technique characterized by starting etching after performing processing by Cl₂ plasma using the substrate which discharged by having used the silicon (Si) substrate and having accustomed with the plasma of etching gas after cleaning, and formed the oxide film (SiO₂) on Si substrate further.

[Claim 2] The plasma-etching technique which carries out dummy etching of every one silicon substrate and oxide-film substrate which formed the same pattern as the aforementioned processed substrate before starting etching, after performing cleaning by the gas plasma containing the aforementioned fluorine, training electric discharge, and Cl₂ plasma treatment in the plasma-etching technique according to claim 1.

[Claim 3] The plasma-etching technique which makes the processing time of the aforementioned silicon substrate the just-etching time of the aforementioned processed substrate which performs etching processing in dummy etching according to claim 2, and makes the processing time of an oxide-film substrate the over etching time of the aforementioned processed substrate which performs etching processing.

[Claim 4] The plasma-etching technique that the gas containing the aforementioned fluorine according to claim 1 is the independent gas or mixed gas of 2 3 fluoride [6 fluoride / sulfur / (SF₆) and nitrogen] (NF₃) and xenon fluoride (XeF₂), a fluorine (F₂), and 3 fluoride-salt ** (ClF₃).

[Claim 5] The plasma-etching technique which ends training electric discharge and starts etching when it acts as the monitor of the emission spectrum of SiF and time change of the intensity of this emission spectrum becomes below a constant value in the aforementioned training electric discharge according to claim 1.

[Claim 6] The plasma-etching technique which uses the mixed gas of Cl₂ and SiCl₄ as process gas in the aforementioned training electric discharge according to claim 1 using the substrate or the quartz substrate in which the oxide film (SiO₂) was formed on Si front face.

[Claim 7] The plasma-etching technique which ends Cl₂ plasma treatment and starts etching when it acts as the monitor of the emission spectrum of Si and time change of the intensity of this emission spectrum becomes below a constant value in the aforementioned Cl₂ plasma treatment according to claim 1.

[Claim 8] The plasma-etching technique using [on the aforementioned Cl₂ plasma treatment according to claim 1 and] a quartz substrate.

[Claim 9] The plasma-etching technique which makes temperature of the discharge tube at the time of etching start, or temperature of a processing room 100 degrees C or more in the plasma-etching technique according to claim 1.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] this invention relates to the plasma-etching technique, and relates to silicon, polycrystal silicon, or the suitable plasma-etching technique for etching of a silicide especially.

[0002]

[Description of the Prior Art] Conventionally, like the publication to Hiratsuka **** and "chamber cleaning of dry-process equipment" washing design 1992.Summer, and P41-53, in plasma processes, such as etching, it cleans in order to prevent grain contamination of a wafer, and in order to lose the residue of the processing interior of a room after cleaning, post cleaning is performed. When SF6 and NF3 gas are used for cleaning, N2, Ar, H2, and O2 gas plasma are used for post cleaning.

[0003]

[Problem(s) to be Solved by the Invention] By the conventional etching technique, it was not taken into consideration about the influence affect the etching property of the residue of the processing interior of a room after cleaning, but the etch rate of the oxide film of silicon and a substratum layer decreased with cleaning after-treatment number of sheets, and there was a trouble of changing **** of a substratum oxide film.

[0004] The purpose of this invention is to offer the etching technique by which a decrement of the silicon after cleaning and the etch rate of an oxide film is suppressed, change of **** of a substratum oxide film is prevented, and the homogeneity between good wafers is acquired.

[0005]

[Means for Solving the Problem] The above-mentioned purpose is attained by performing Cl2 gas plasma treatment (Cl2 electric discharge) using the silicon substrate or quartz substrate of a dummy which discharged by having accustomed after cleaning using the silicon substrate of a dummy by Cl2 or the mixed-gas plasma of Cl2 and O2 which is etching gas (seasoning), next formed the oxide film in the silicon front face after training electric discharge, and being made to perform predetermined etching processing after that.

[0006]

[Function] First, by discharging by accustoming after cleaning by Cl2 or the mixed-gas plasma of Cl2 and O2 which is etching gas (seasoning) By being able to decrease the influence of the remains fluorine of the processing interior of a room after cleaning, accustoming to a degree, and performing Cl2 plasma treatment by Cl2 gas plasma after electric discharge The influence of the resultant of the silicon of the processing interior of a room after training electric discharge can be decreased, a decrement of the silicon after cleaning and the etch rate of an oxide film is suppressed, change of **** of a substratum oxide film is prevented, and the homogeneity between good wafers can be acquired.

[0007]

[Example] First, after cleaning to drawing 4 with SF6 gas plasma, change by the processing number of sheets of the emission spectrum of SiF (wavelength of 441nm) at the time of etching silicon with Cl2 gas plasma is shown in it. The intensity of the emission spectrum of SiF generated by the reaction of silicon and a fluorine decreases with processing number of sheets, and becomes almost fixed. The processing interior of a room found that the fluorine remained after cleaning by the gas which contains a fluorine from this. Change of the etch rate of the emission spectrum of SiF at the time of adding SF6 gas in Cl2 gas, silicon, and an oxide film is shown in drawing 5 and the drawing 6. As shown in drawing 5 and the drawing 6, the intensity of the emission spectrum of SiF (wavelength of 441nm) increases with the increase in the addition of SF6. The etch rate of silicon and an oxide film increases with the increase in the addition of SF6. The etch rate of silicon and an oxide film was changed by the remains fluorine from this, and it found out that the etch rate of silicon and an oxide film fell with a decrement of a remains fluorine.

[0008] Etching of the silicon by the above-mentioned Cl2 gas plasma is equivalent to the training electric discharge after cleaning, i.e., seasoning. The processing interior of a room after seasoning found that the resultant (Si or SiClx) of a silicon system remained from the emission spectrum of Si. Change of the etch rate of the oxide film at the time of adding SiCl4 gas in Cl2 gas is shown in drawing 7. The etch rate of an oxide film decreases with the increase in the addition of SiCl4. The etch rate of the silicon oxide immediately after seasoning was found out decreasing for the resultant of this silicon system.

[0009] By removing the fluorine which performs seasoning after cleaning by the plasma containing a fluorine, and remains to the processing interior of a room after cleaning by these above-mentioned The plasma treatment which could suppress change of the etch rate of silicon and an oxide film, and used Cl2 gas after seasoning further, That is, Cl2 electric discharge was performed and

it found out that change of the etch rate of an oxide film could be suppressed by removing the resultant of the silicon which remains to the processing interior of a room after seasoning.

[0010] Hereafter, the drawing 1 or the drawing 3 explains one example of this invention. Drawing 3 is drawing having shown the outline of the microwave plasma etching system which is an example of the plasma-treatment equipment for enforcing the technique of this invention. The microwave oscillated from the magnetron 1 spreads a waveguide 2, and is led to the processing room 4 through the discharge tube made from a quartz 3. The cleaning gas (SF₆) supplied by the magnetic field formed of the direct current supplied to solenoid coils 6 and 7 from DC power supply for magnetic-field occurrence 5 and the microwave electric field from the etching gas supply system 8, seasoning gas (Cl₂ gas), Cl₂ discharge gas (Cl₂), and etching gas (Cl₂ gas) are plasma-ized at each step.

[0011] First, cleaning of the processing room 4 is performed by SF₆ gas plasma. Then, seasoning of the processing room 4 is performed by Cl₂ gas plasma using a silicon substrate. Cl₂ electric discharge is performed using the silicon substrate or quartz substrate which furthermore formed the oxide film in the silicon front face. Etching of the wafer 10 currently laid in the installation electrode 9 by Cl₂ gas is performed after cleaning, seasoning, and Cl₂ electric discharge. The pressure at the time of cleaning, seasoning, Cl₂ electric discharge, and etching is controlled by the evacuation equipment 11. Moreover, the energy of the ion which carries out incidence to a wafer is controlled by RF power supplied to the installation electrode 9 from RF generator 12.

[0012] The difference in change of the silicon at the time of performing the case where there is no seasoning, seasoning, and Cl₂ electric discharge, and the etch rate of an oxide film is shown in drawing 1 and the drawing 2. Cl₂ gas plasma performed seasoning, and seasoning was suspended when the photogenesis intensity ratio of the spectrum which carried out the monitor of the emission spectrum of SiF every 10 seconds, and was measured to time t (n) and time t (n-1) was set to 1×0.002 . By performing seasoning after cleaning, the influence of remains of the fluorine generated at the time of cleaning is suppressed, and change of an etch rate can be prevented. Cl₂ electric discharge does not impress RF power, but removes the resultant of silicon by Cl₂ gas plasma. When the photogenesis intensity ratio of the spectrum which carried out the monitor of the emission spectrum of Si every 10 seconds, and was measured to time t (n) and time t (n-1) was set to 1×0.002 , Cl₂ electric discharge was stopped. By performing Cl₂ electric discharge after seasoning, the influence of remains of the resultant of the silicon generated at the time of seasoning is suppressed, and change of the etch rate of a substratum oxide film can be prevented.

[0013] According to this example, the influence of the remains fluorine after cleaning can be suppressed, and change of the etch rate of silicon and an oxide film can be prevented. Moreover, the influence of the resultant of the silicon after seasoning can be suppressed, and change of the etch rate of a substratum oxide film can be prevented.

[0014] Although this example explained the effect about the microwave plasma etching system, the same effect is acquired also in other electric discharge methods (PE), for example, a plasma etching, Helicon, and TCP (Transformer Coupled Plasma).

[0015]

[Effect of the Invention] According to this invention, the influence of the resultant of the remains fluorine after cleaning and the silicon after seasoning is suppressed, and it is effective in the ability to prevent change of the etch rate of silicon and an oxide film.

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Field

[Field of the Invention] this invention relates to the plasma-etching technique, and relates to silicon, polycrystal silicon, or the suitable plasma-etching technique for etching of a silicide especially.

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Technique

[Description of the Prior Art] Conventionally, like the publication to Hiratsuka **** and "chamber cleaning of dry-process equipment" washing design 1992. Summer, and P41-53, in plasma processes, such as etching, it cleans in order to prevent grain contamination of a wafer, and in order to lose the residue of the processing interior of a room after cleaning, post cleaning is performed. When SF6 and NF3 gas are used for cleaning, N2, Ar, H2, and O2 gas plasma are used for post cleaning.

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Effect

[Effect of the Invention] According to this invention, the influence of the resultant of the remains fluorine after cleaning and the silicon after seasoning is suppressed, and it is effective in the ability to prevent change of the etch rate of silicon and an oxide film.

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] By the conventional etching technique, it was not taken into consideration about the influence affect the etching property of the residue of the processing interior of a room after cleaning, but the etch rate of the oxide film of silicon and a substratum layer decreased with cleaning after-treatment number of sheets, and there was a trouble of changing **** of a substratum oxide film.

[0004] The purpose of this invention is to offer the etching technique by which a decrement of the silicon after cleaning and the etch rate of an oxide film is suppressed, change of **** of a substratum oxide film is prevented, and the homogeneity between good wafers is acquired.

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MEANS

[Means for Solving the Problem] The above-mentioned purpose is attained by performing Cl₂ gas plasma treatment (Cl₂ electric discharge) using the silicon substrate or quartz substrate of a dummy which discharged by having accustomed after cleaning using the silicon substrate of a dummy by Cl₂ or the mixed-gas plasma of Cl₂ and O₂ which is etching gas (seasoning), next formed the oxide film in the silicon front face after training electric discharge, and being made to perform predetermined etching processing after that.

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OPERATION

[Function] First, by discharging by accustoming after cleaning by Cl₂ or the mixed-gas plasma of Cl₂ and O₂ which is etching gas (seasoning) By being able to decrease the influence of the remains fluorine of the processing interior of a room after cleaning, accustoming to a degree, and performing Cl₂ plasma treatment by Cl₂ gas plasma after electric discharge The influence of the resultant of the silicon of the processing interior of a room after training electric discharge can be decreased, a decrement of the silicon after cleaning and the etch rate of an oxide film is suppressed, change of **** of a substratum oxide film is prevented, and the homogeneity between good wafers can be acquired.

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EXAMPLE

[Example] First, after cleaning to drawing 4 with SF₆ gas plasma, change by the processing number of sheets of the emission spectrum of SiF (wavelength of 441nm) at the time of etching silicon with Cl₂ gas plasma is shown in it. The intensity of the emission spectrum of SiF generated by the reaction of silicon and a fluorine decreases with processing number of sheets, and becomes almost fixed. The processing interior of a room found that the fluorine remained after cleaning by the gas which contains a fluorine from this. Change of the etch rate of the emission spectrum of SiF at the time of adding SF₆ gas in Cl₂ gas, silicon, and an oxide film is shown in drawing 5 and the drawing 6. As shown in drawing 5 and the drawing 6, the intensity of the emission spectrum of SiF (wavelength of 441nm) increases with the increase in the addition of SF₆. The etch rate of silicon and an oxide film increases with the increase in the addition of SF₆. The etch rate of silicon and an oxide film was changed by the remains fluorine from this, and it found out that the etch rate of silicon and an oxide film fell with a decrement of a remains fluorine.

[0008] Etching of the silicon by the above-mentioned Cl₂ gas plasma is equivalent to the training electric discharge after cleaning, i.e., seasoning. The processing interior of a room after seasoning found that the resultant (Si or SiCl_x) of a silicon system remained from the emission spectrum of Si. Change of the etch rate of the oxide film at the time of adding SiCl₄ gas in Cl₂ gas is shown in drawing 7. The etch rate of an oxide film decreases with the increase in the addition of SiCl₄. The etch rate of the silicon oxide immediately after seasoning was found out decreasing for the resultant of this silicon system.

[0009] By removing the fluorine which performs seasoning after cleaning by the plasma containing a fluorine, and remains to the processing interior of a room after cleaning by these above-mentioned The plasma treatment which could suppress change of the etch rate of silicon and an oxide film, and used Cl₂ gas after seasoning further, That is, Cl₂ electric discharge was performed and it found out that change of the etch rate of an oxide film could be suppressed by removing the resultant of the silicon which remains to the processing interior of a room after seasoning.

[0010] Hereafter, the drawing 1 or the drawing 3 explains one example of this invention. Drawing 3 is drawing having shown the outline of the microwave plasma etching system which is an example of the plasma-treatment equipment for enforcing the technique of this invention. The microwave oscillated from the magnetron 1 spreads a waveguide 2, and is led to the processing room 4 through the discharge tube made from a quartz 3. The cleaning gas (SF₆) supplied by the magnetic field formed of the direct current supplied to solenoid coils 6 and 7 from DC power supply for magnetic-field occurrence 5 and the microwave electric field from the etching gas supply system 8, seasoning gas (Cl₂ gas), Cl₂ discharge gas (Cl₂), and etching gas (Cl₂ gas) are plasma-ized at each step.

[0011] First, cleaning of the processing room 4 is performed by SF₆ gas plasma. Then, seasoning of the processing room 4 is performed by Cl₂ gas plasma using a silicon substrate. Cl₂ electric discharge is performed using the silicon substrate or quartz substrate which furthermore formed the oxide film in the silicon front face. Etching of the wafer 10 currently laid in the installation electrode 9 by Cl₂ gas is performed after cleaning, seasoning, and Cl₂ electric discharge. The pressure at the time of cleaning, seasoning, Cl₂ electric discharge, and etching is controlled by the evacuation equipment 11. Moreover, the energy of the ion which carries out incidence to a wafer is controlled by RF power supplied to the installation electrode 9 from RF generator 12.

[0012] The difference in change of the silicon at the time of performing the case where there is no seasoning, seasoning, and Cl₂ electric discharge, and the etch rate of an oxide film is shown in drawing 1 and the drawing 2. Cl₂ gas plasma performed seasoning, and seasoning was suspended when the photogenesis intensity ratio of the spectrum which carried out the monitor of the emission spectrum of SiF every 10 seconds, and was measured to time t (n) and time t (n-1) was set to 1**0.002. By performing seasoning after cleaning, the influence of remains of the fluorine generated at the time of cleaning is suppressed, and change of an etch rate can be prevented. Cl₂ electric discharge does not impress RF power, but removes the resultant of silicon by Cl₂ gas plasma. When the photogenesis intensity ratio of the spectrum which carried out the monitor of the emission spectrum of Si every 10 seconds, and was measured to time t (n) and time t (n-1) was set to 1**0.002, Cl₂ electric discharge was stopped. By performing Cl₂ electric discharge after seasoning, the influence of remains of the resultant of the silicon generated at the time of seasoning is suppressed, and change of the etch rate of a substratum oxide film can be prevented.

[0013] According to this example, the influence of the remains fluorine after cleaning can be suppressed, and change of the etch rate of silicon and an oxide film can be prevented. Moreover, the influence of the resultant of the silicon after seasoning can be suppressed, and change of the etch rate of a substratum oxide film can be prevented.

[0014] Although this example explained the effect about the microwave plasma etching system, the same effect is acquired also in other electric discharge methods (PE), for example, a plasma etching, Helicon, and TCP (Transformer Coupled Plasma).

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is drawing showing the processing number-of-sheets dependency of SiO₂ etch rate in one example of this invention.

[Drawing 2] It is drawing showing the processing number-of-sheets dependency of Si etch rate in one example of this invention.

[Drawing 3] It is drawing showing the configuration of the microwave plasma etching system which shows an example of the equipment for enforcing the technique of this invention.

[Drawing 4] It is the processing number-of-sheets dependency **** view of SiF photogenesis intensity.

[Drawing 5] It is drawing showing SF₆ addition dependency of SiF photogenesis intensity.

[Drawing 6] It is drawing showing SF₆ addition dependency of Si and SiO₂ etch rate.

[Drawing 7] It is drawing showing SiCl₄ addition dependency of SiO₂ etch rate.

[Description of Notations]

3 [-- An etching gas supply system, 10 / -- Wafer.] -- The discharge tube made from a quartz, 6, 7 -- A solenoid coil, 8

[Translation done.]